EUB Alberta Energy and Utilities Board

Evaluating the Potential for CO_2 Sequestration in Coal Beds in the Alberta Basin, Canada

Stefan Bachu and Andrew Beaton

Alberta Geological Survey
Alberta Energy and Utilities Board

AGS

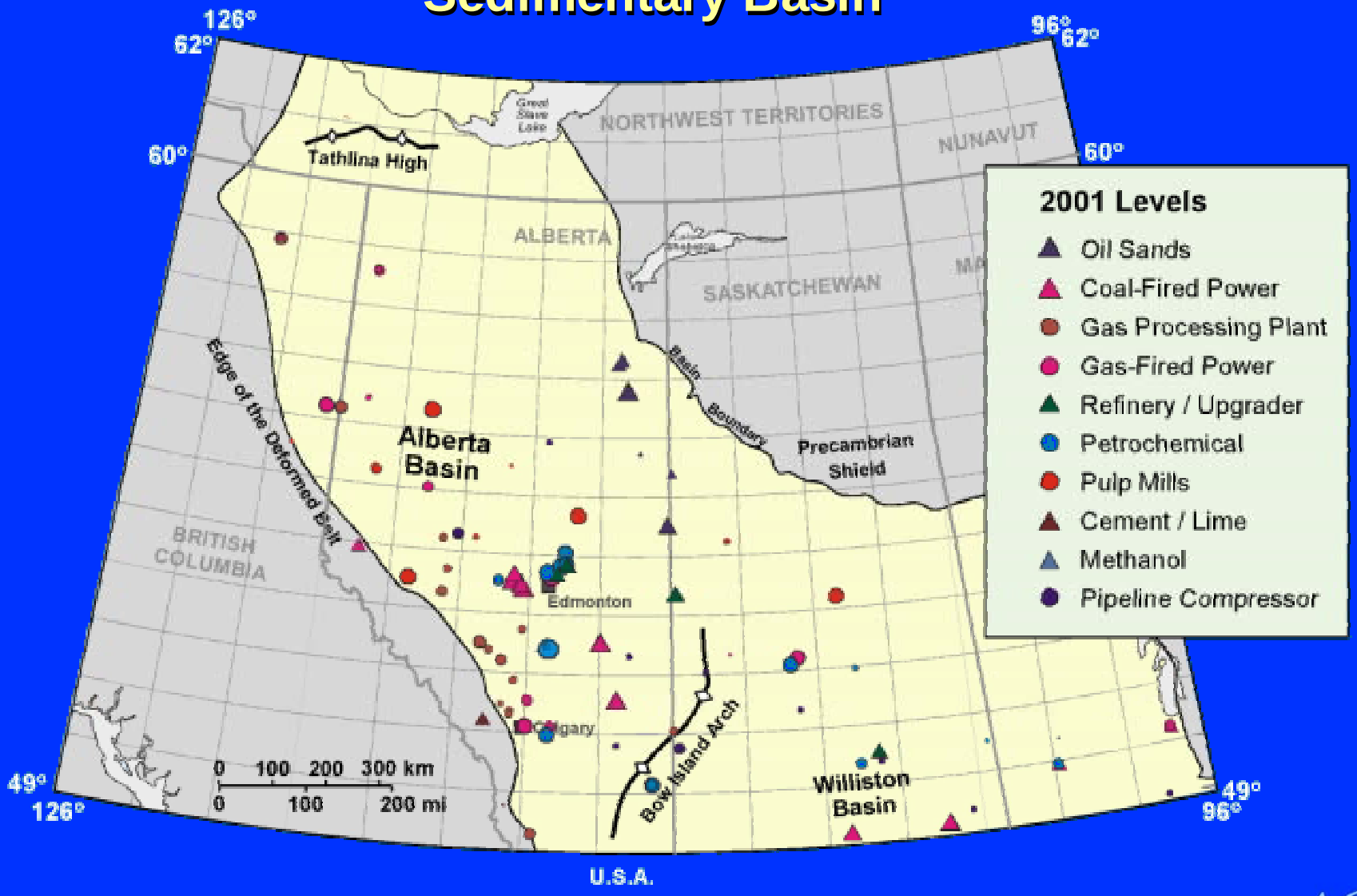
EUB Alberta Energy and Utilities Board

Canada's Sedimentary Basins

AGS

EUB Alberta Energy and Utilities Board

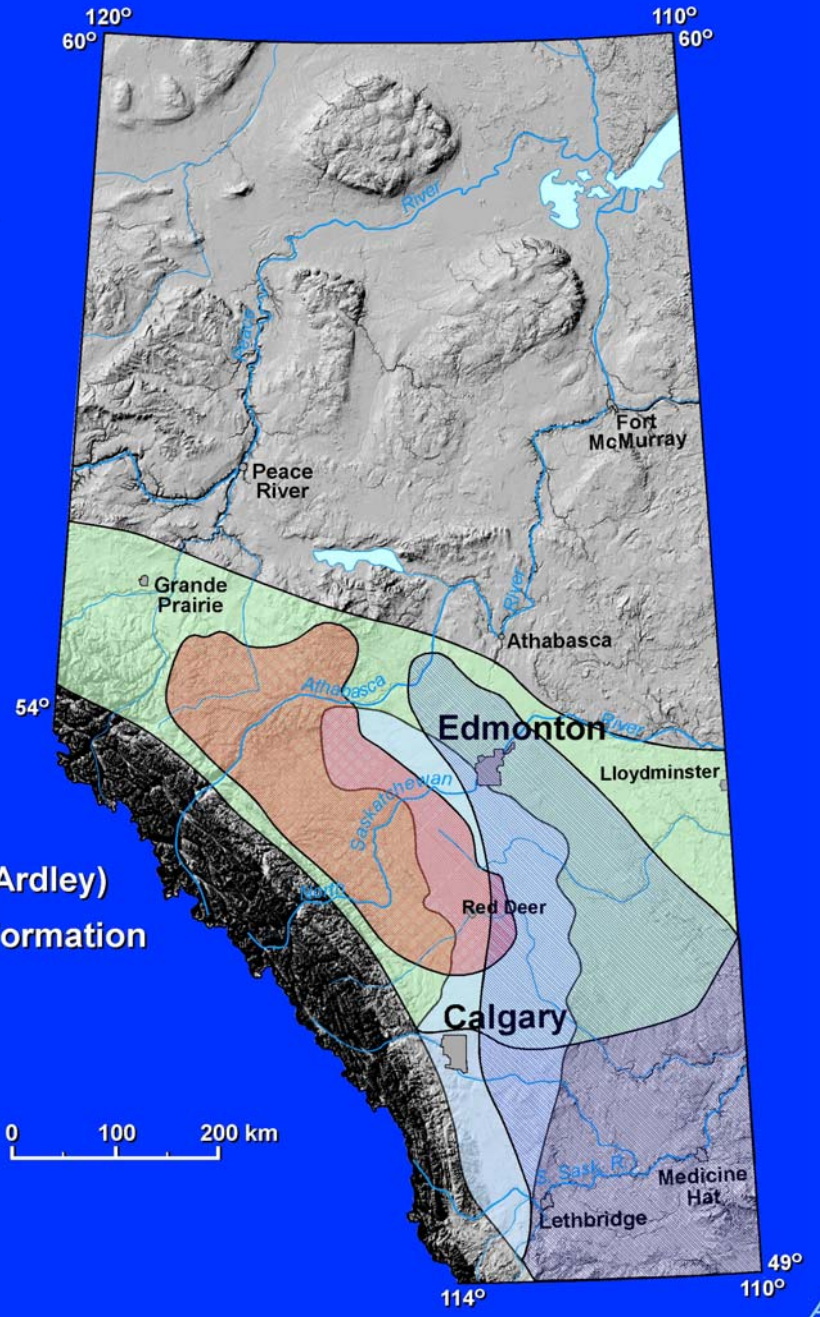
Major CO_2 Sources in the Western Canada Sedimentary Basin



AGS

EUB Alberta Energy and Utilities Board

Extent of Cretaceous and Tertiary Coal Zones in Alberta

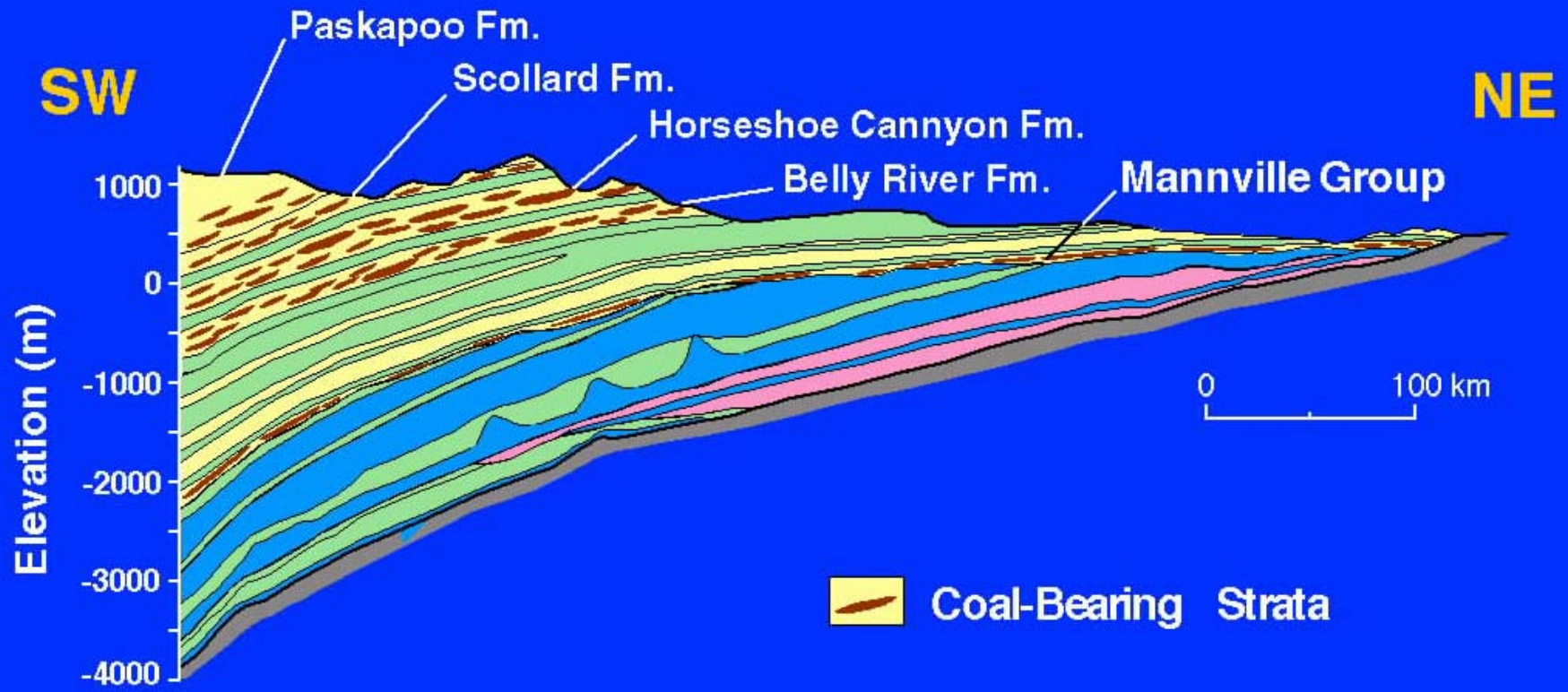


- Scollard Formation (Ardley)
- Horseshoe Canyon Formation
- Belly River Group
- Mannville Group

AGS

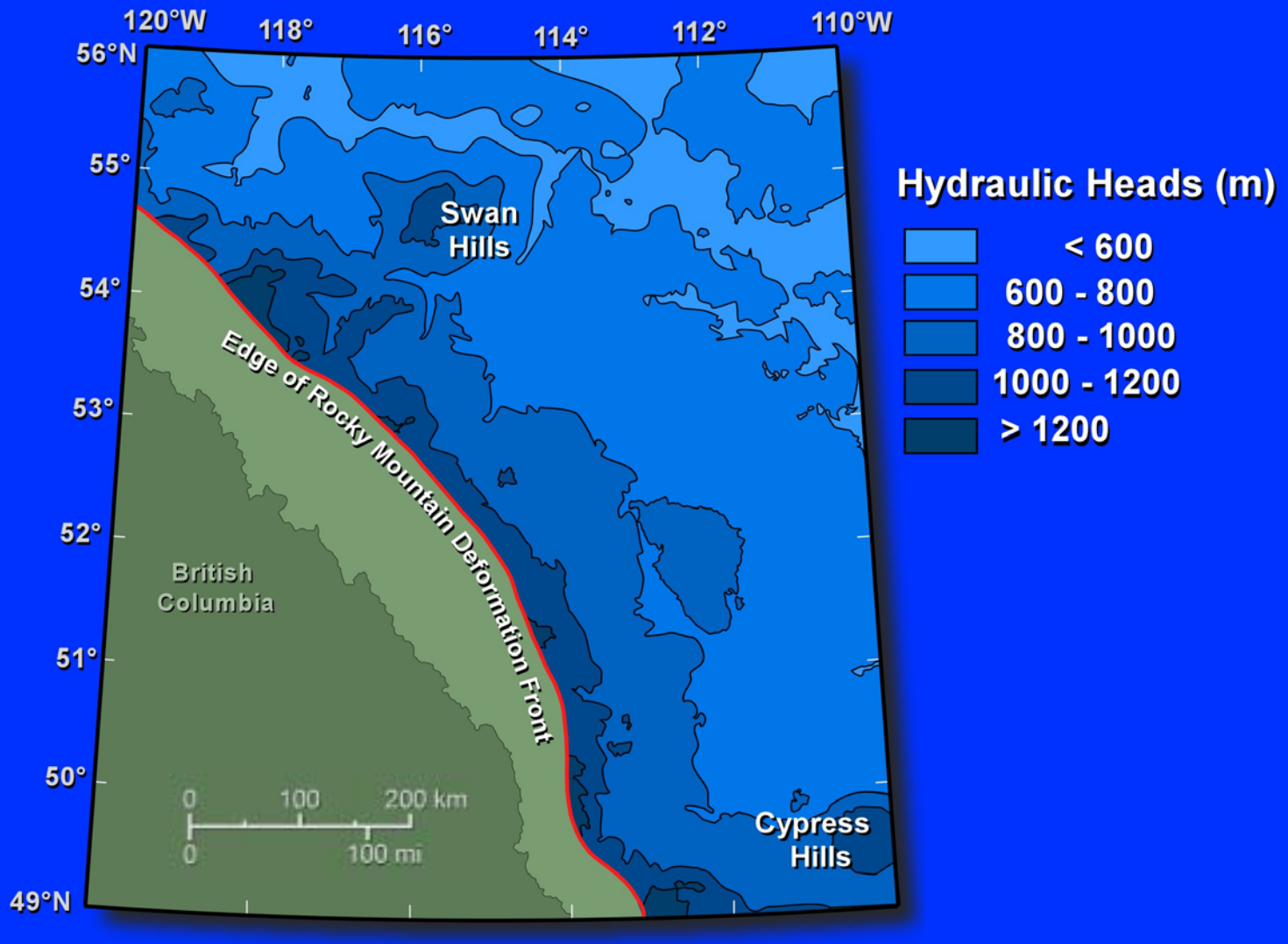
EUB Alberta Energy and Utilities Board

Coal-Bearing Strata in the Alberta Basin



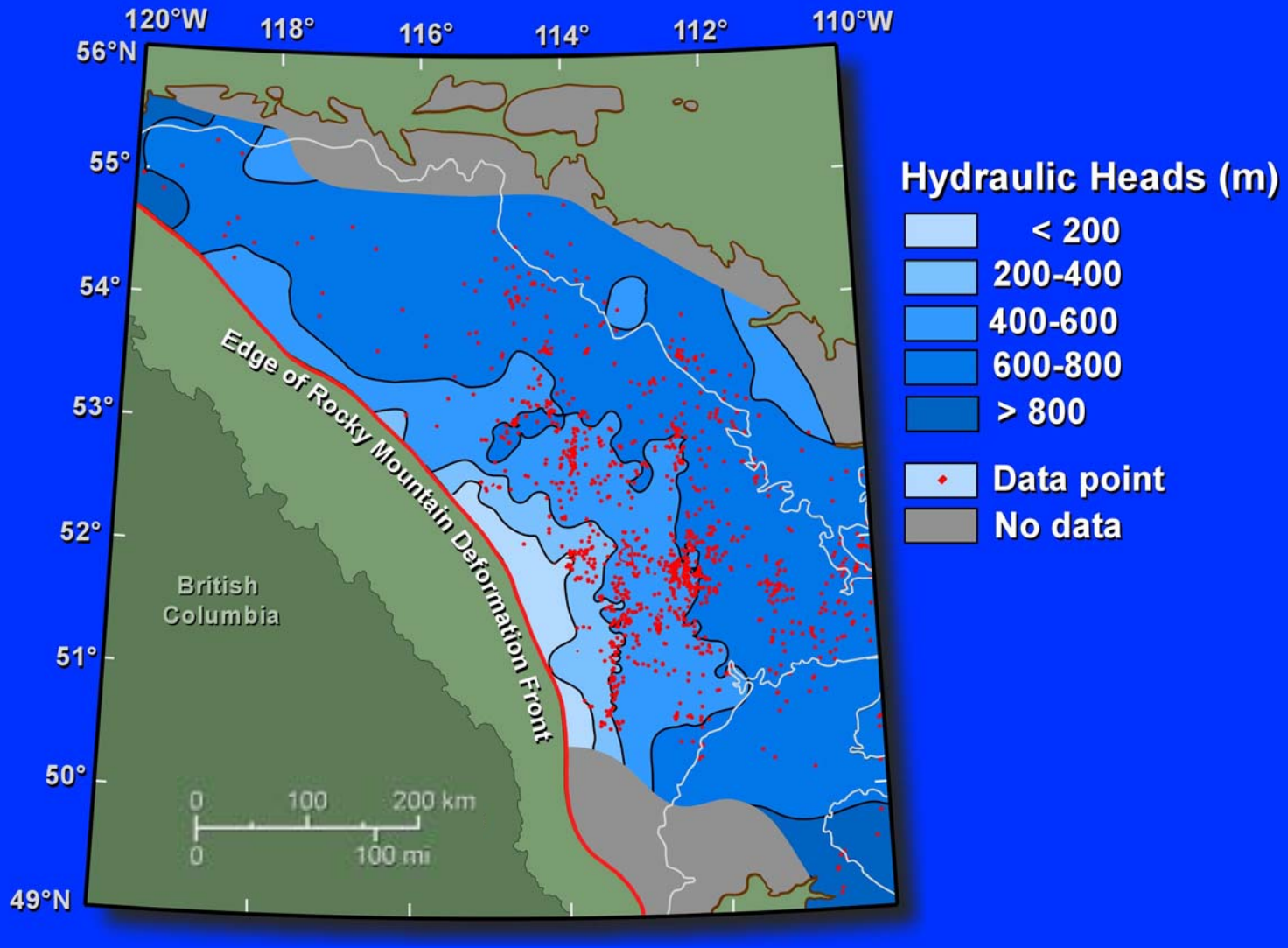
AGS

Water Table Elevation



EUB Alberta Energy and Utilities Board

Hydraulic Heads in the Basal Belly River Aquifer



AGS

EUB Alberta Energy and Utilities Board

Characteristics of Cretaceous and Tertiary Coal Beds in the Alberta Basin

Group or Formation	Coal Zone	Depth Range (m)	Thickness (m)	Net Pay (m)	Thickest Seam (m)	Rank	Temp. (ºC)	Pressure (MPa)	Water Salinity (g/l)
Scollard	Ardley	0 - 900	30 - 200	6 - 21	5	subbit. to HVB-C	5 - 35	0.1 - 9	0.5 - 3
Horseshoe Canyon	Carbon-Thompson	0 - 1100	10 - 40	2 - 3	2	HVB-C			0.5 - 7.5
Horseshoe Canyon	Drumheller	0 - 1300	20 - 200	2 - 18	4	subbit. to HVB-C	5 - 62	0.1 - 10	0.5 - 7.5
Belly River	Lethbridge	100 - 1600	10 - 30	1 - 3	1	subbit. to HVB-B	5 - 62	0.1 - 12	0.5 - 13
Belly River	Taber	200 - 600	10 - 40	1 - 6	2	HVB-C			1 - 17
Belly River	McKay	300 - 1700	10 - 30	1 - 5	2	subbit. to HVB-C	5 - 65	0.1 - 14	1 - 17
Mannville	Mannville	500 - 3000	20 - 150	2 - 14	7	subbit. to HVB	15 - 124	4.9 - 29	5 - 160

Subbit. = Subbituminous

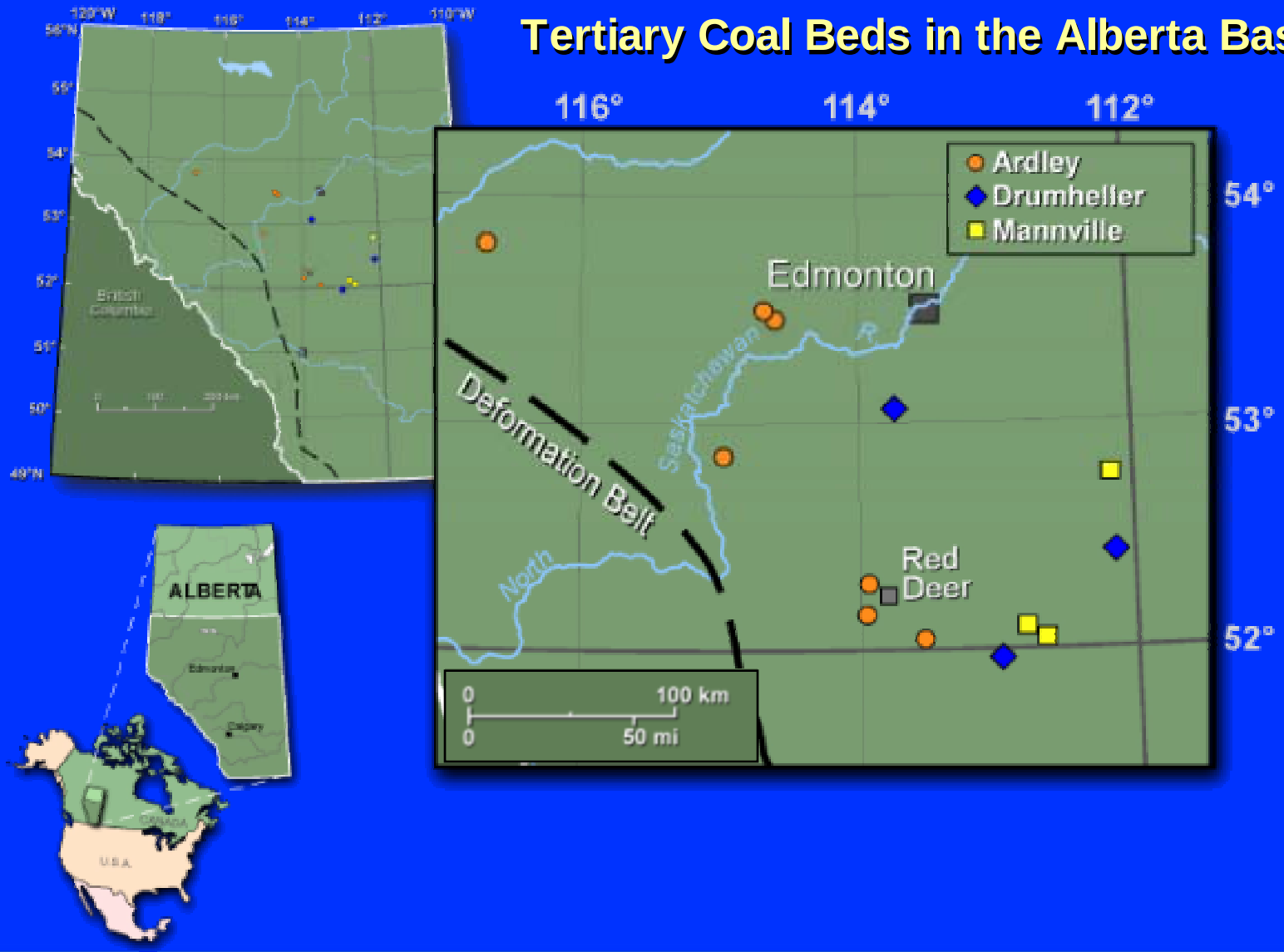
HVB-C = high volatile bituminous C rank

HVB-B = High volatile bituminous B rank

AGS

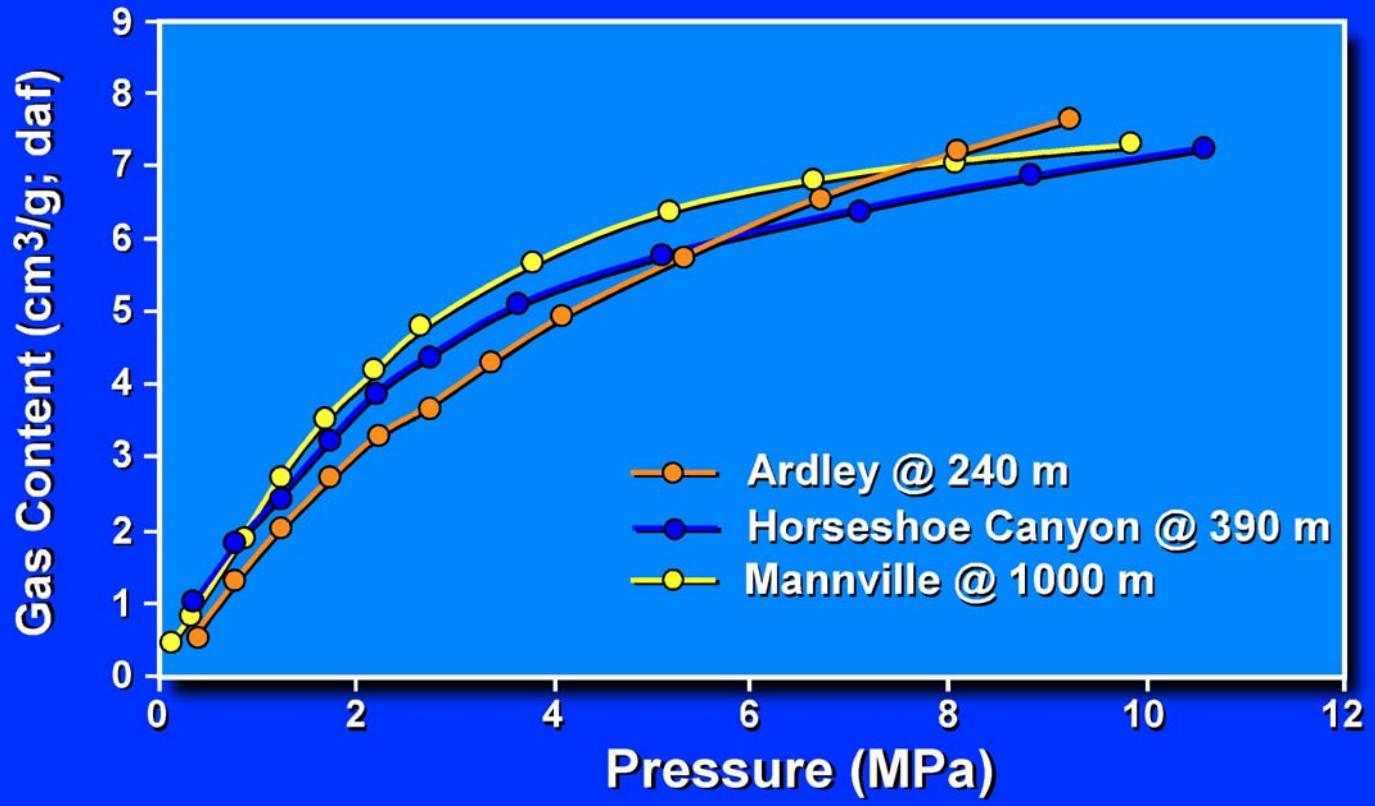
EUB Alberta Energy and Utilities Board

Location of Methane and CO2 Adsorption Isotherm Data for Cretaceous and Tertiary Coal Beds in the Alberta Basin

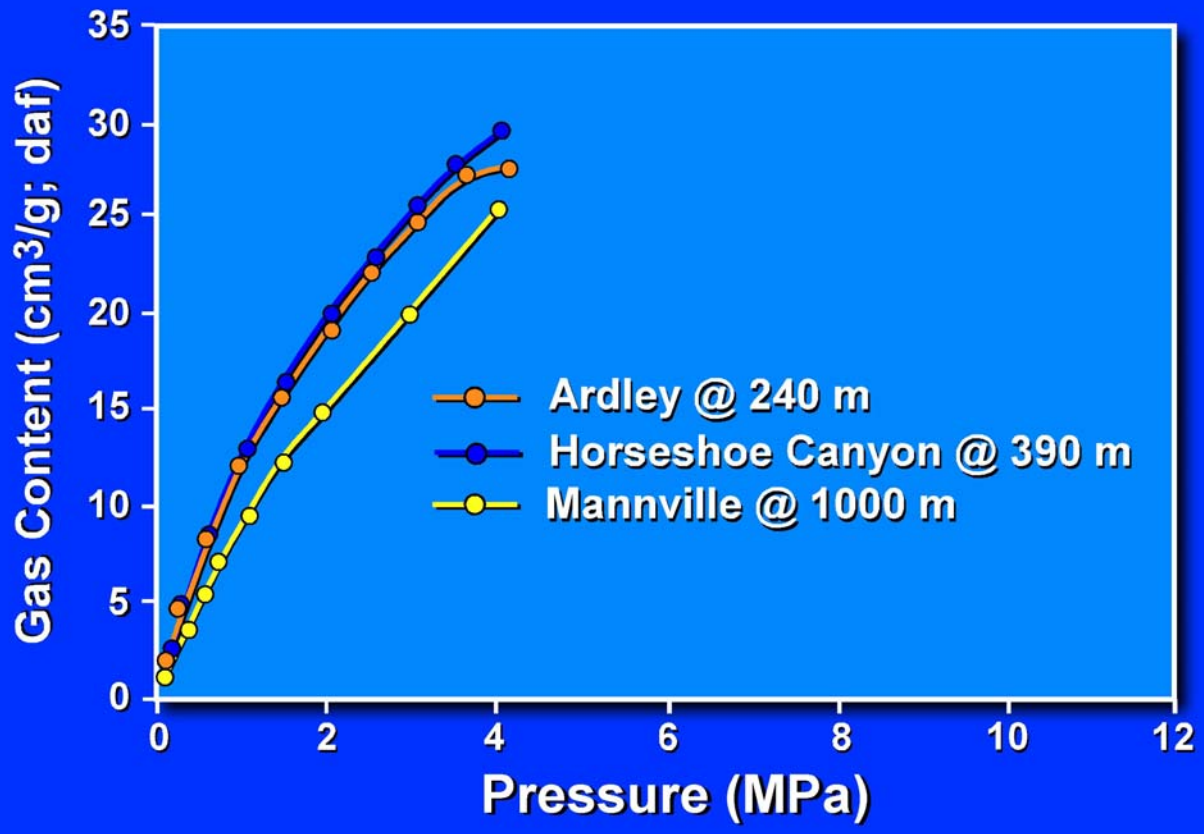


AGS

Methane Adsorption Isotherms for Cretaceous and Tertiary Coals in the Alberta Basin

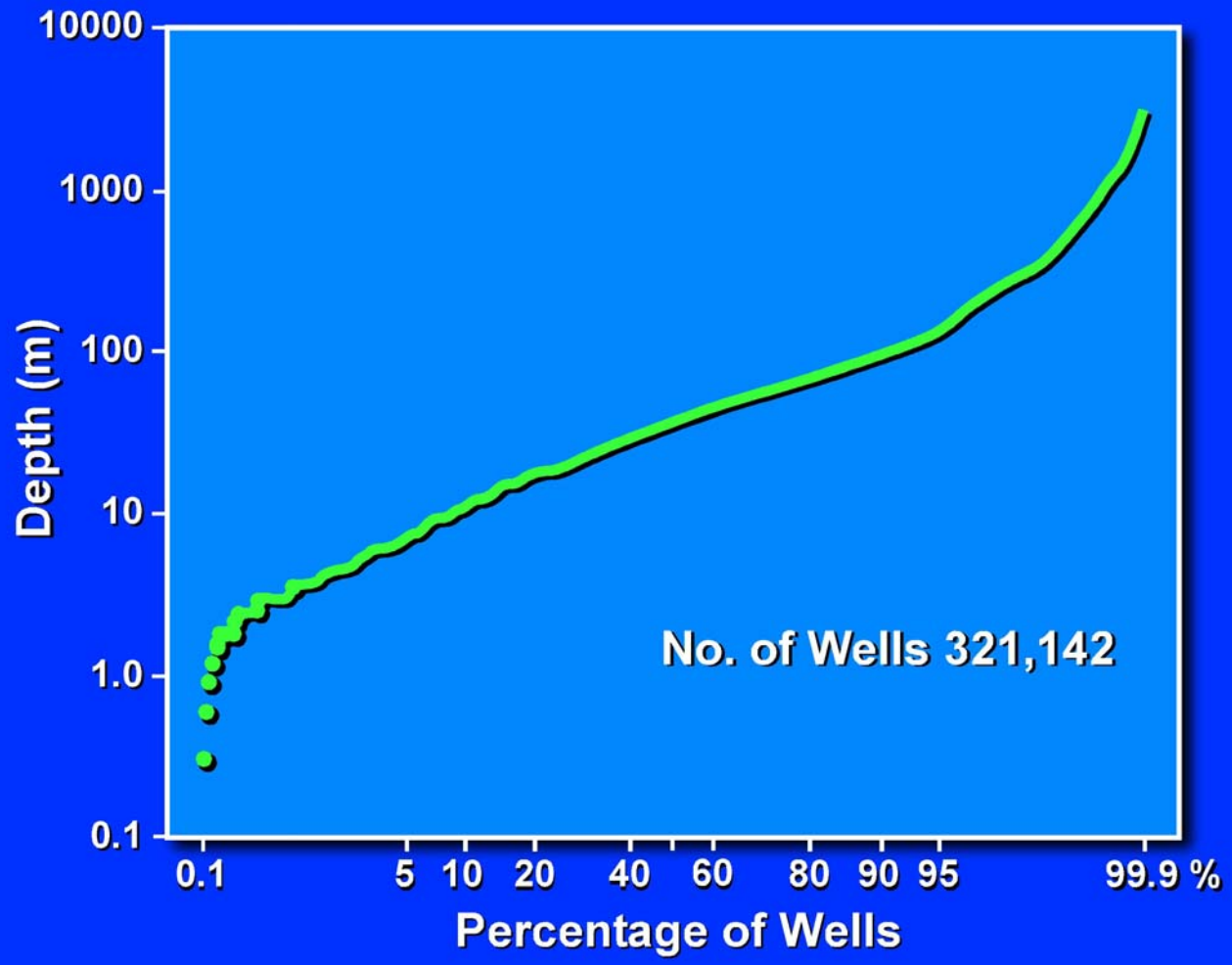


CO_2 Adsorption Isotherms for Cretaceous and Tertiary Coals in the Alberta Basin



EUB Alberta Energy and Utilities Board

Depth of Water Wells in the Coal Bearing Plains Region of the Alberta Basin



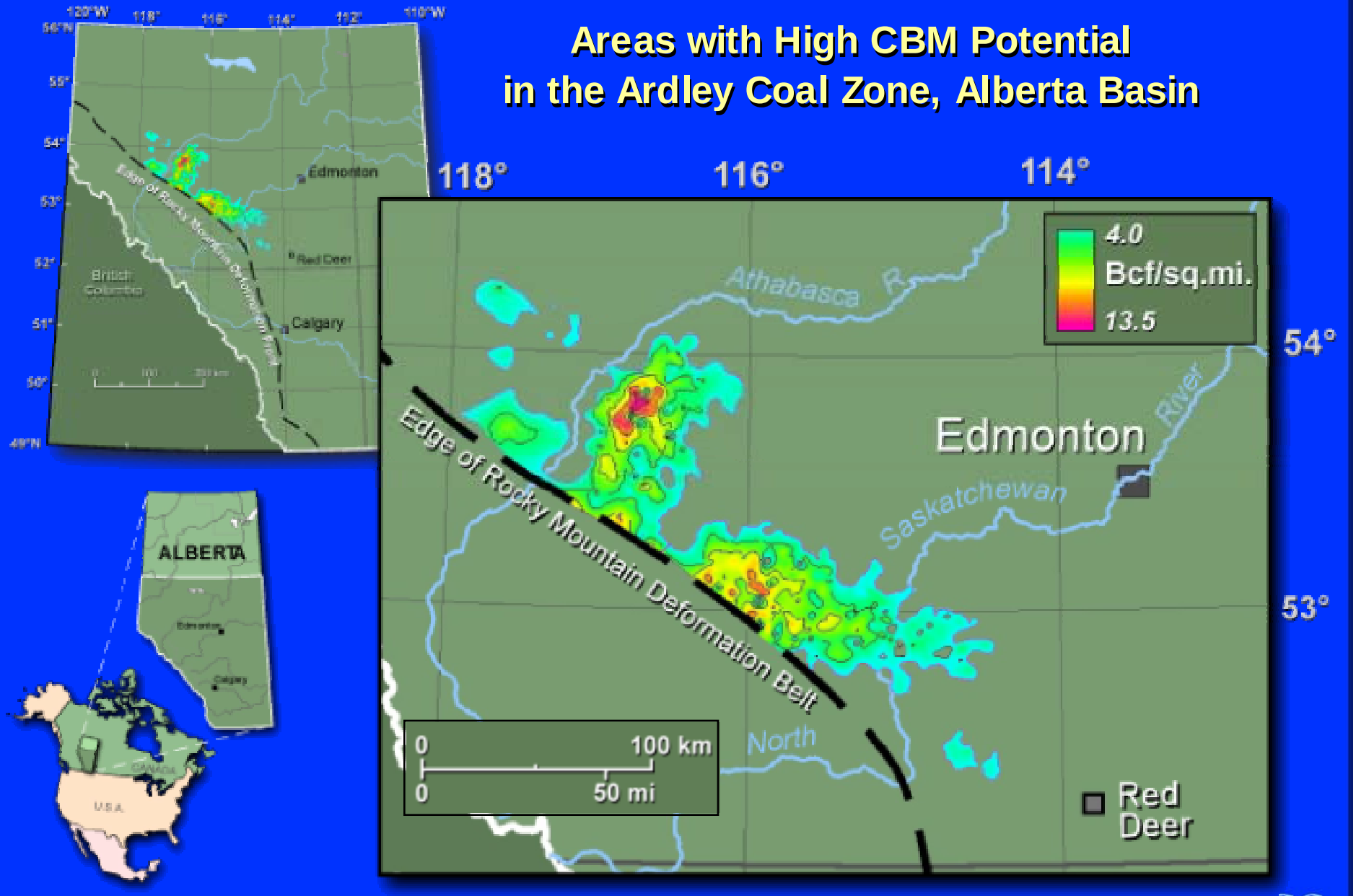
AGS

Capacity Calculations

- Depth between 300 m and 1500 m m
- Based on coal thickness and tonnage
- Based on actual coal bed pressure and temperature distributions
- Based on CH_4 and CO_2 adsorption isotherms for each coal bed

EUB Alberta Energy and Utilities Board

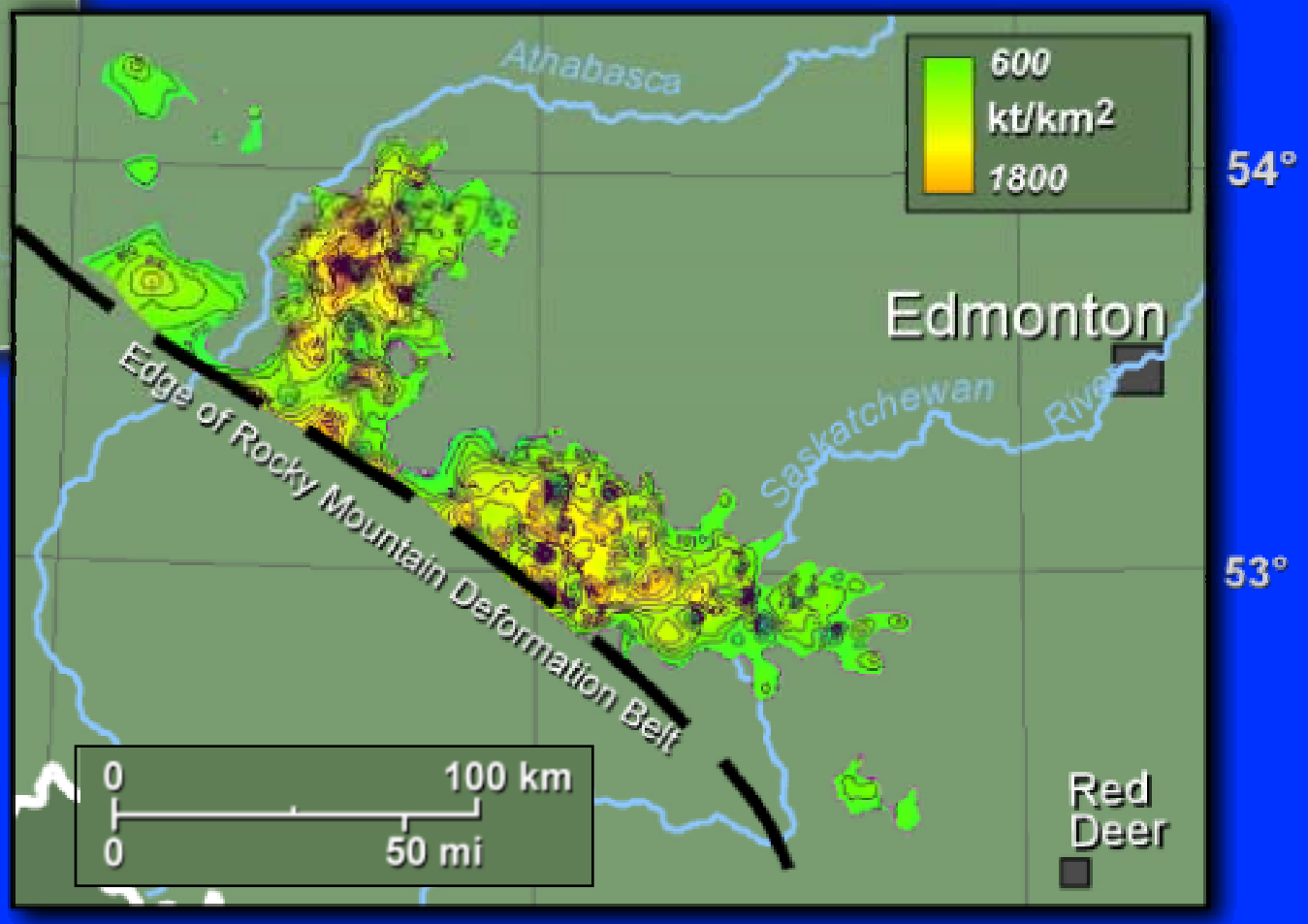
Areas with High CBM Potential in the Ardley Coal Zone, Alberta Basin



AGS

EUB Alberta Energy and Utilities Board

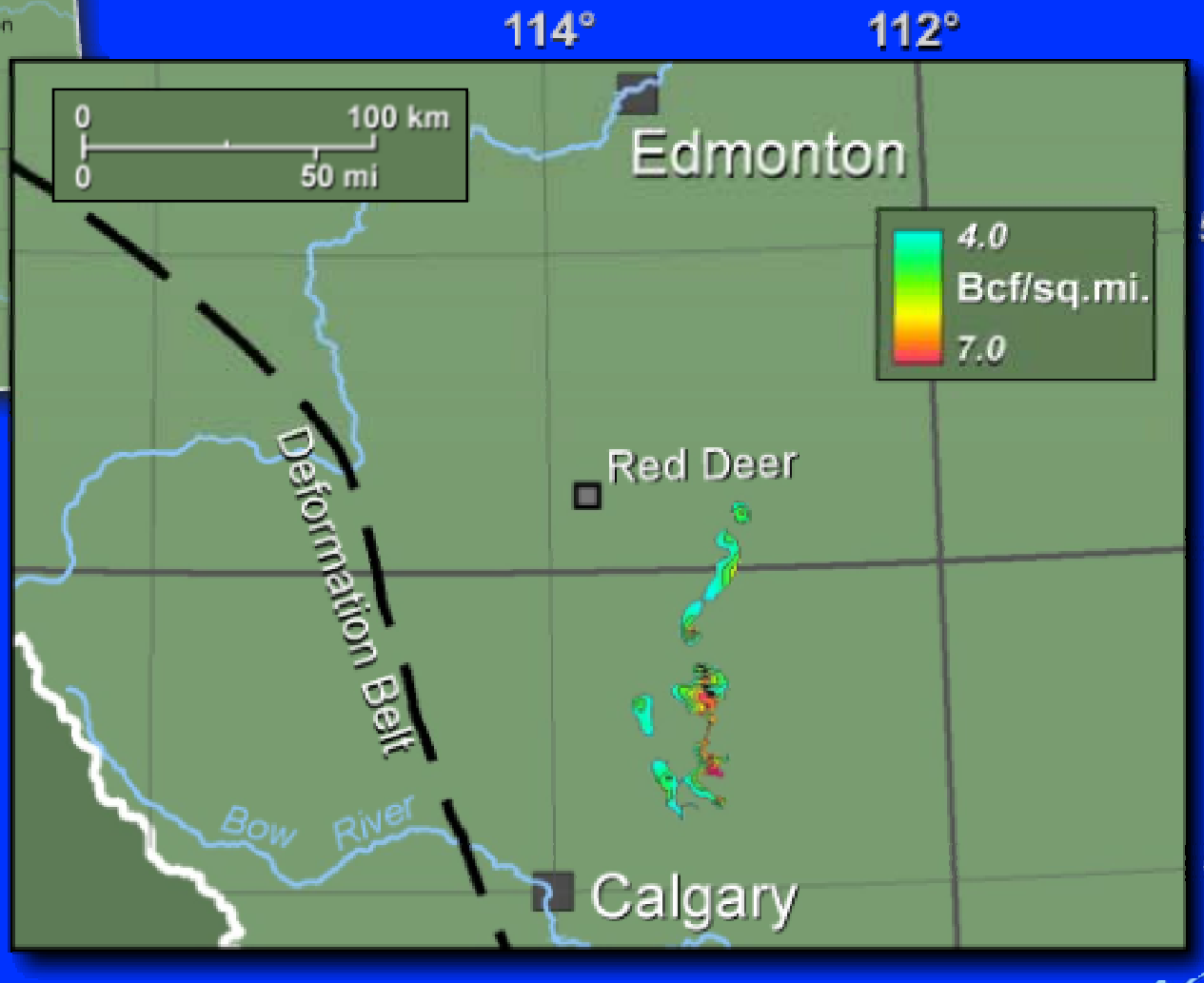
CO_2 Storage Capacity in the Areas with High CBM Potential, Ardley Coal Zone, Alberta Basin



AGS

EUB Alberta Energy and Utilities Board

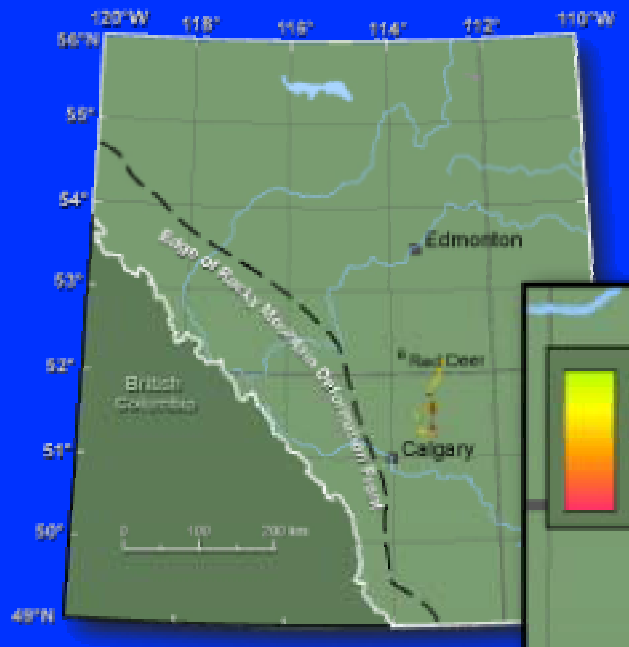
Areas with High CBM Potential in the Drumheller Coal Zone, Alberta Basin

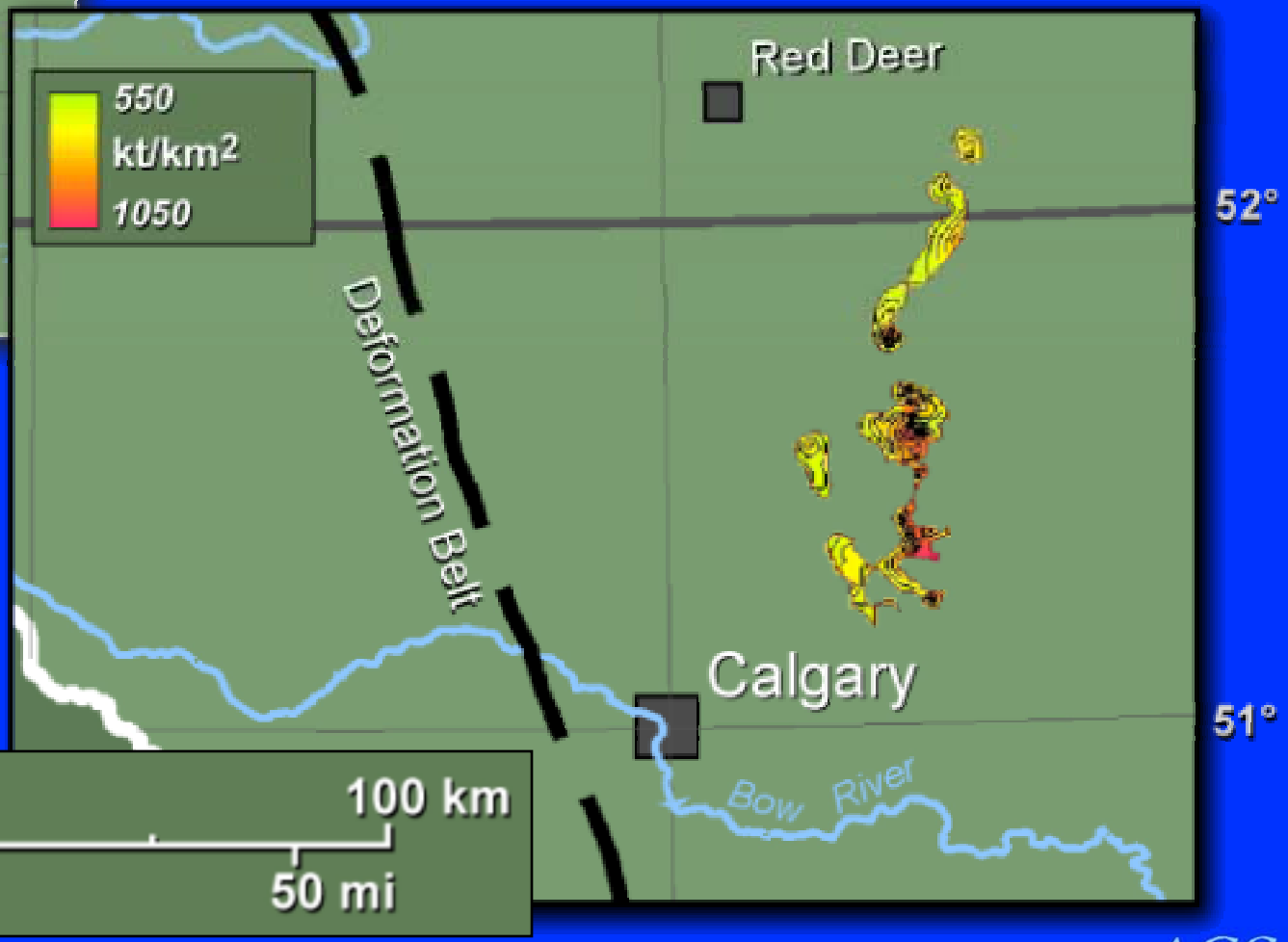


AGS

EUB Alberta Energy and Utilities Board

CO_2 Storage Capacity in the Areas with High CBM Potential, Drumheller Coal Zone, Alberta Basin

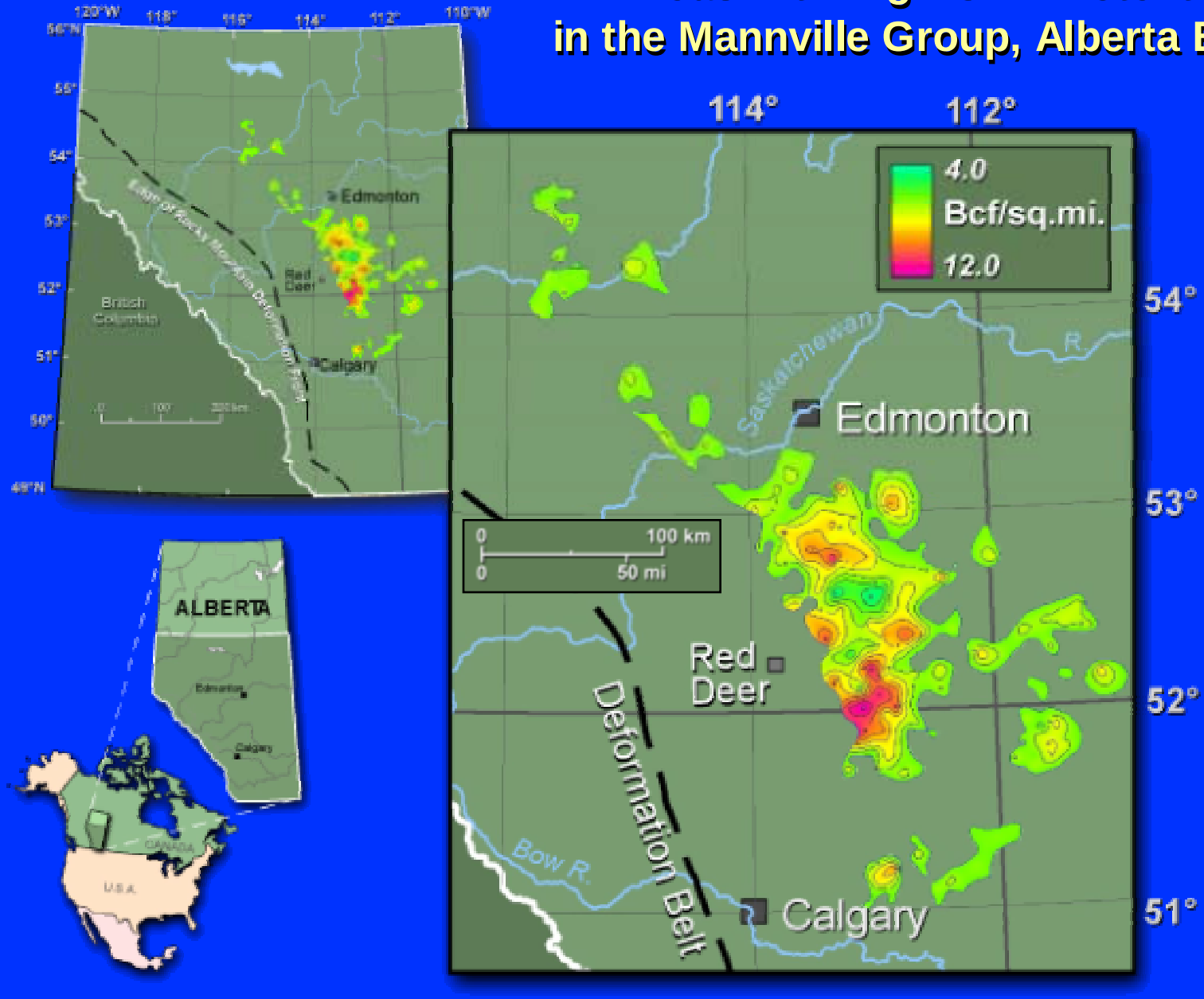




AGS

EUB Alberta Energy and Utilities Board

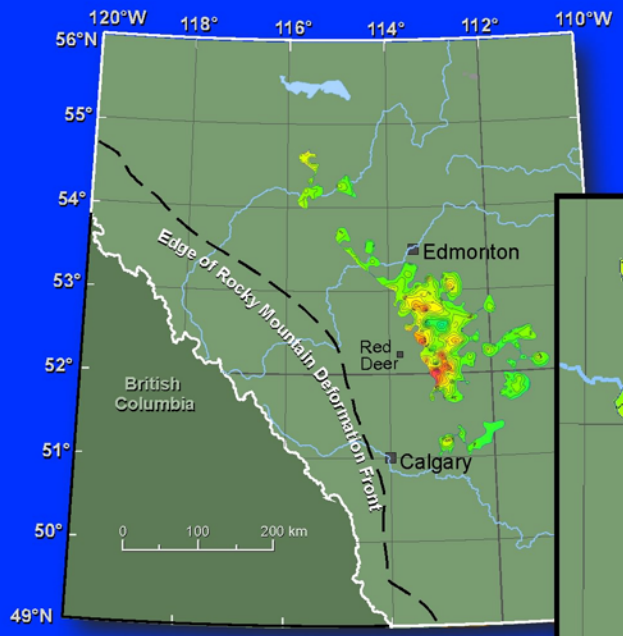
Areas with High CBM Potential in the Mannville Group, Alberta Basin

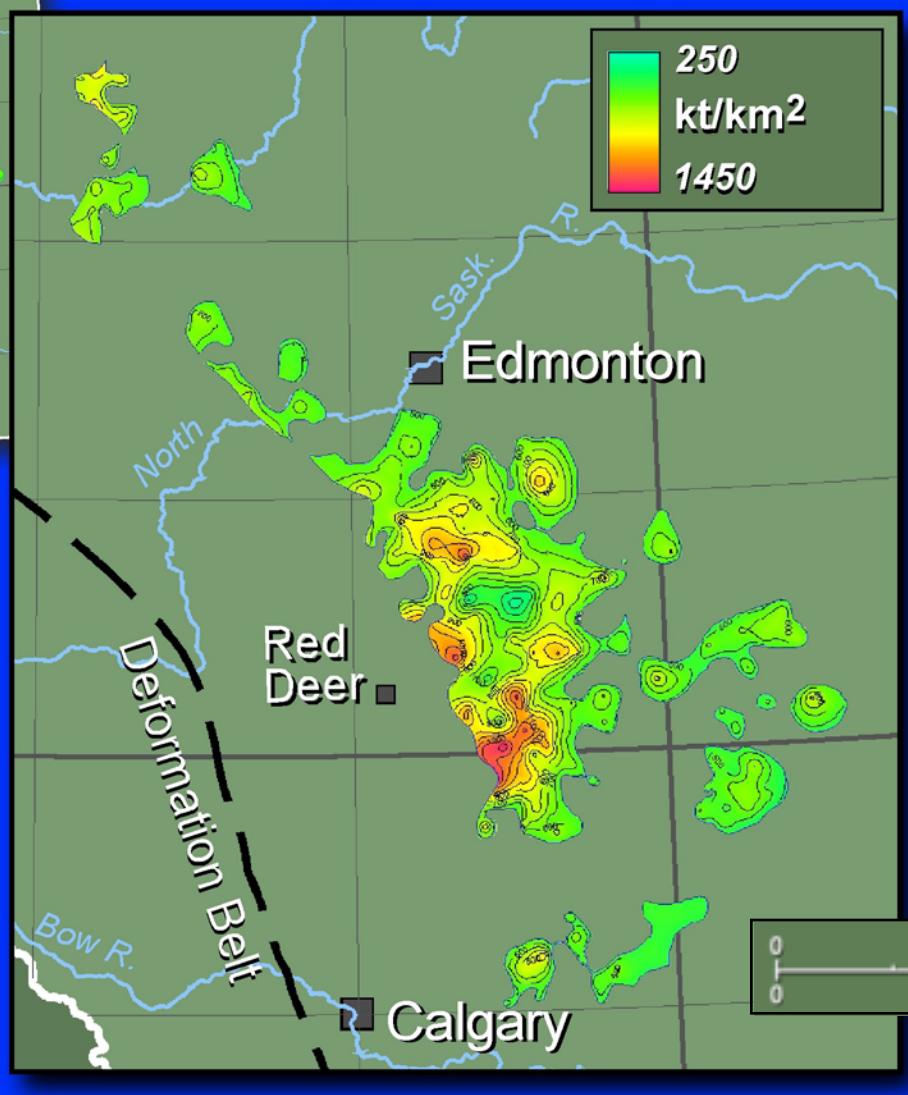


AGS

EUB Alberta Energy and Utilities Board

CO_2 Storage Capacity in the Areas with High CBM Potential, Mannville Group, Alberta Basin





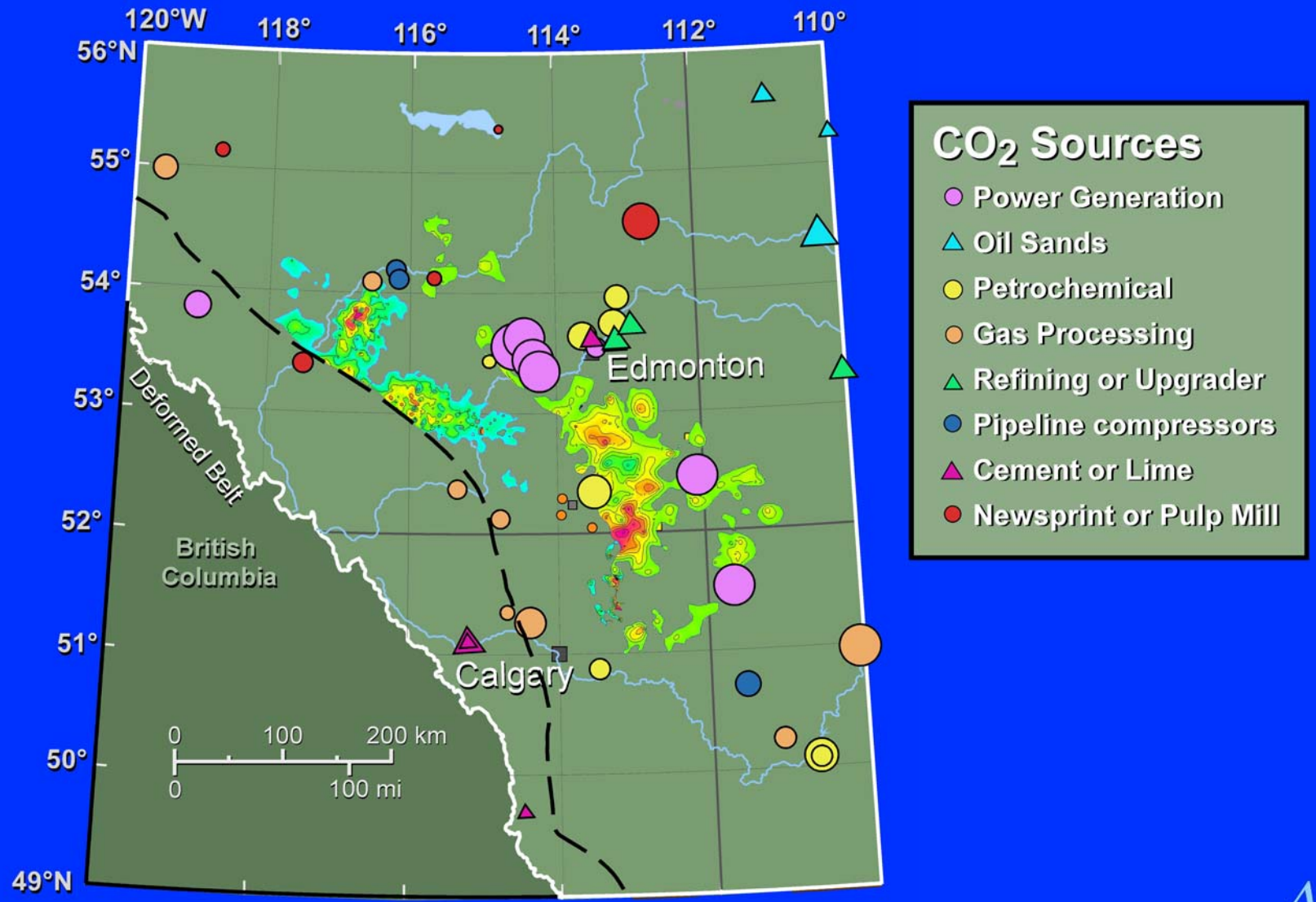
AGS

CBM and CO_2 Storage Capacity in Areas with High CBM Potential in Coal Beds in the Alberta Basin

Coal Zone	Area (1000 km²)	CBM Capacity Bcf/sq.mi.	CBM Capacity Tcf	CO_2 Capacity Mt/km²	CO_2 Capacity Gt
Ardley	10.36	4 - 13.5	22.5	600 - 1800	9.9
Drumheller	0.76	4 - 7	1.3	550 - 1050	0.5
Mannville	18.35	4 - 12	34.8	250 - 1450	12.5

EUB Alberta Energy and Utilities Board

Major CO_2 Sources and Areas with High CBM Potential and CO_2 Storage Capacity in Coal Beds in the Alberta Basin



AGS

Summary and Conclusions - 1

- Cretaceous and Tertiary coals in the Alberta basin are found at depths ranging from surface to 3000 m
- Shallow coals are normally pressured, deep coals are increasingly under-pressured (below hydrostatic)
- Shallow coals are saturated with low-salinity water, some deep coals are saturated with gas (dry coals), and deeper coals are saturated with high-salinity brines

Summary and Conclusions - 2

- Coals vary in rank from Sub-bituminous C to High Volatile Bituminous B
- CO_2 adsorption capacity is up to 6 times higher than that of methane
- Areas with high CBM potential (> 4 Bcf/sq.mi) and CO_2 storage capacity are found in central and western Alberta, relatively close to major CO_2 sources
- Ultimate CBM potential and CO_2 storage capacity in these areas are estimated at 48 Tcf methane and 23 Gt CO_2